THE ERODIBLE CORRIDOR: A KEY TOOL FOR MANAGEMENT OF LARGE GRAVEL-BED RIVERS IN NORTH-EASTERN ITALY

Nicola Surian

Department of Geography, University of Padova, Italy

WORKSHOP
"Great European Dynamic Rivers
and the Free Space for Rivers concept"
Moulins, 23 October 2009

INTRODUCTION

- Gravel bed-rivers in north-eastern Italy: very dynamic rivers
- Main focus of this talk: geomorphological processes
- “Free space for rivers” and “Erodible corridor”: different concepts ?

DOLOMITES

Cellina R.

Tagliamento R.

Piave R.

VENETIAN-FRIULIAN PLAIN

Brenta R.

Venice

ADRIATIC SEA

0 20 km

OUTLINE

1. Application of erodible corridor or similar concepts in Italy (and in particular in north-eastern Italy)
2. Recent dynamics and management of large gravel-bed rivers in north-eastern Italy
3. How to define the erodible corridor

Free space for rivers, erodible corridor and similar concepts

- There are different approaches (hydraulic, geomorphological, ecological) to define these aspects in rivers
- The management purposes can be different

APPLICATION OF ERODIBLE CORRIDOR OR SIMILAR CONCEPTS IN ITALY

"Fascia di pertinenza fluviale": Govi and Turitto (1994)

Applications:

-Plans for flood risks (carried out by Basin Authorities or other agencies)

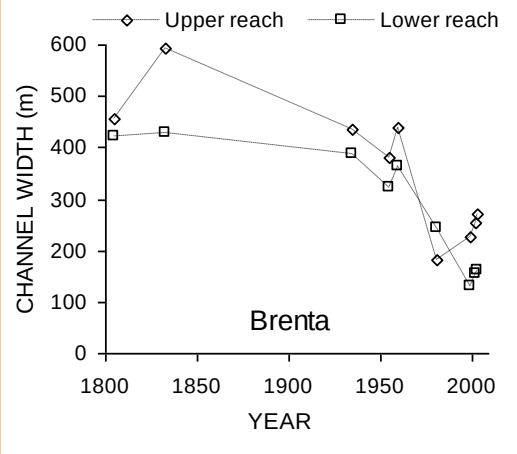
- Few examples that used a geomorphological approach

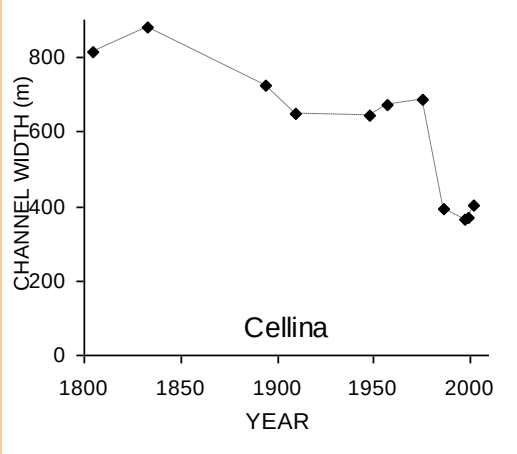
Some limitations: mainly for flood risk, not taking into considerations other aspects (e.g. geomorphological and ecological status and processes)

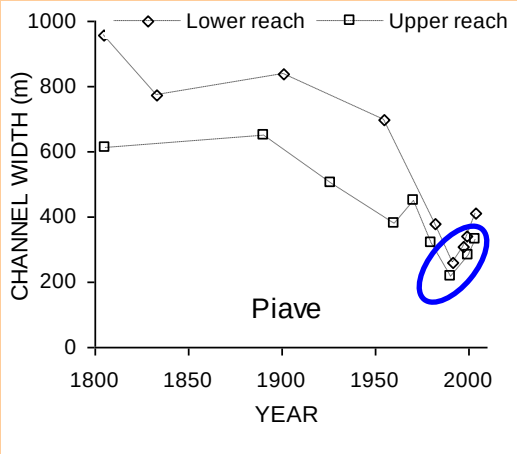
Applications in north-eastern Italy (Basin Authority):

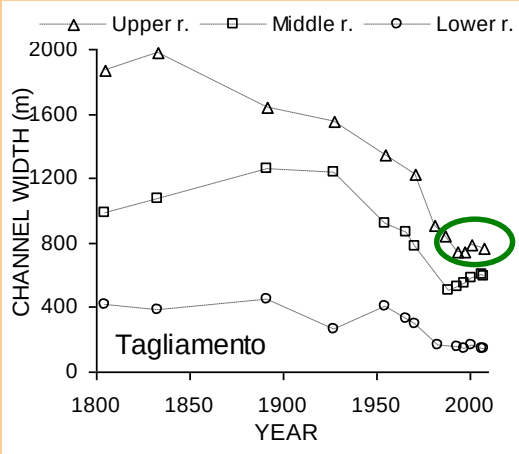
- First studies in 1998
- Tagliamento Plan (not applied yet): an integrated approach

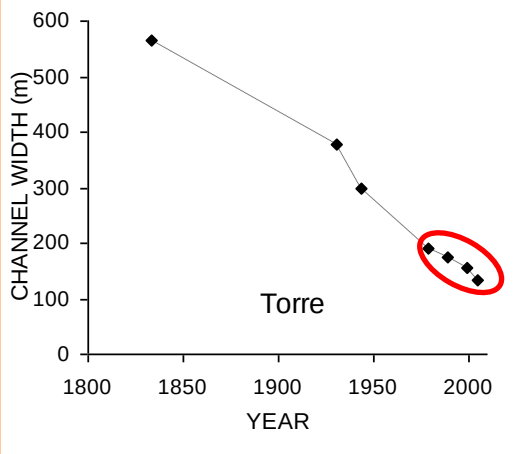
Important note: there are not real application of “erodible corridor concept” in the rivers that are presented here

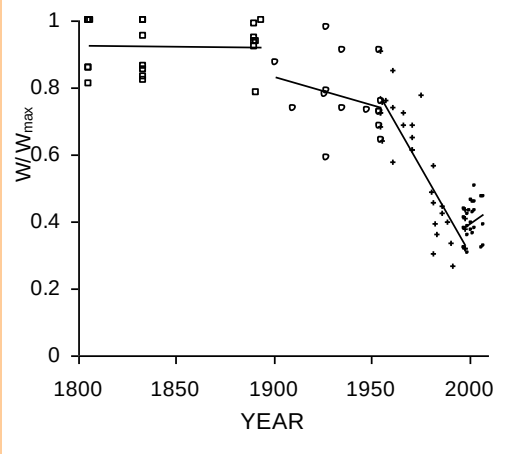






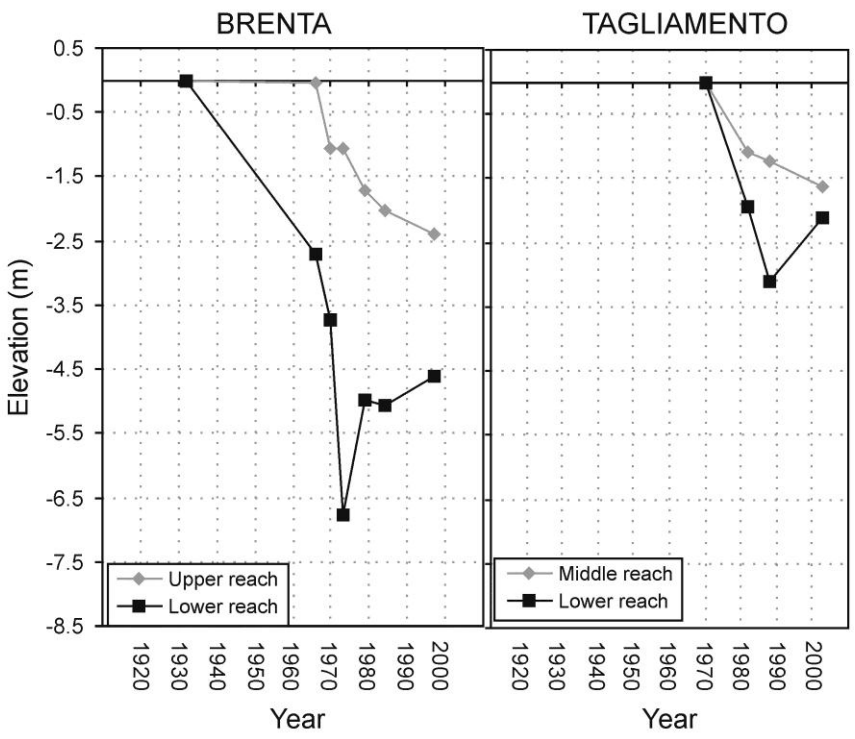






Changes in channel width over the last 200 years

BED-LEVEL CHANGES



CAUSES OF CHANNEL ADJUSTMENTS

- Channelization
- Reforestation
- Dams
- Sediment extraction

→ Alteration of SEDIMENT REGIME

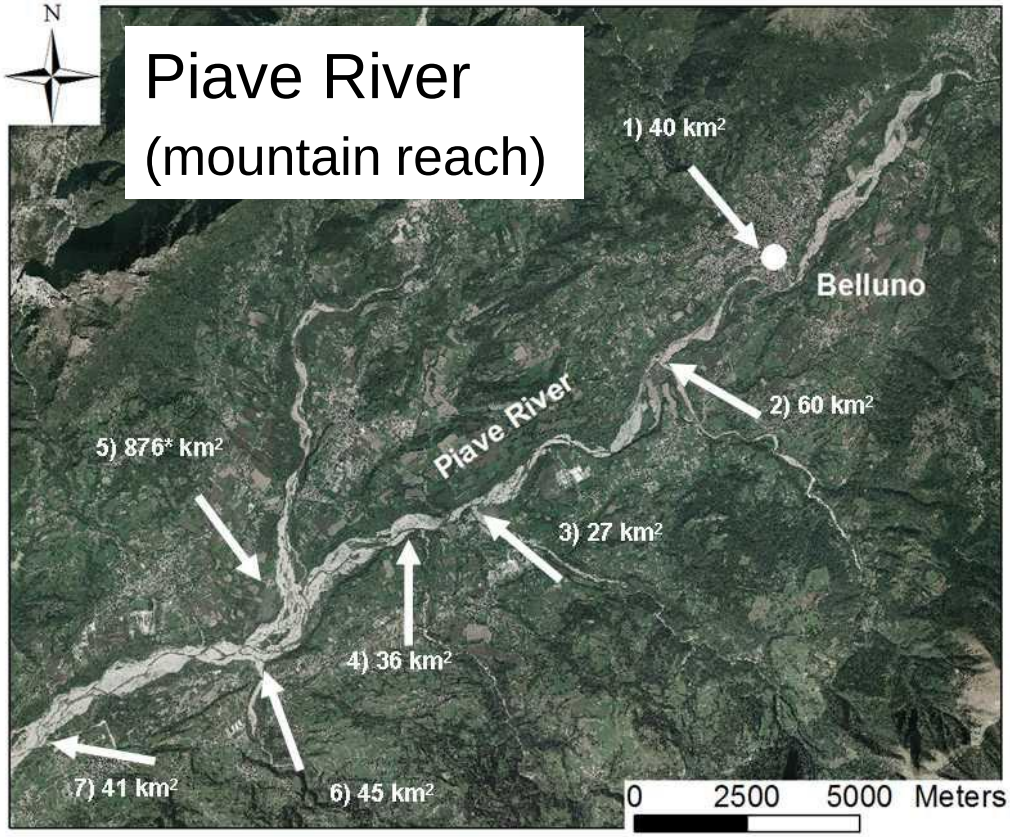
River	Drainage basin area (km^2)	Sediment yield ($m^3\ km^{-2}\ yr^{-1}$)	Dates of intense gravel mining	Extraction yield (official data)* ($m^3\ yr^{-1}$)	Dates of dam closure	Drainage area upstream from dams (%)
Brenta	1567	250-275	1950s-1980s	360,000 (from 1953 to 1977)	1954	40
Piave	3899	180-200	1960s-1980s	N.A.	1930s-1950s	54
Cellina	446	400-450	1970s-1980s	N.A.	1954	87
Tagliamento	2580	400	1970s-early 1990s	1,100,000 (from 1970 to 1991)	1950s	3
Torre	1105	320†	1960s-1970s	750,000 (from 1950s to 1970s)	1900	8

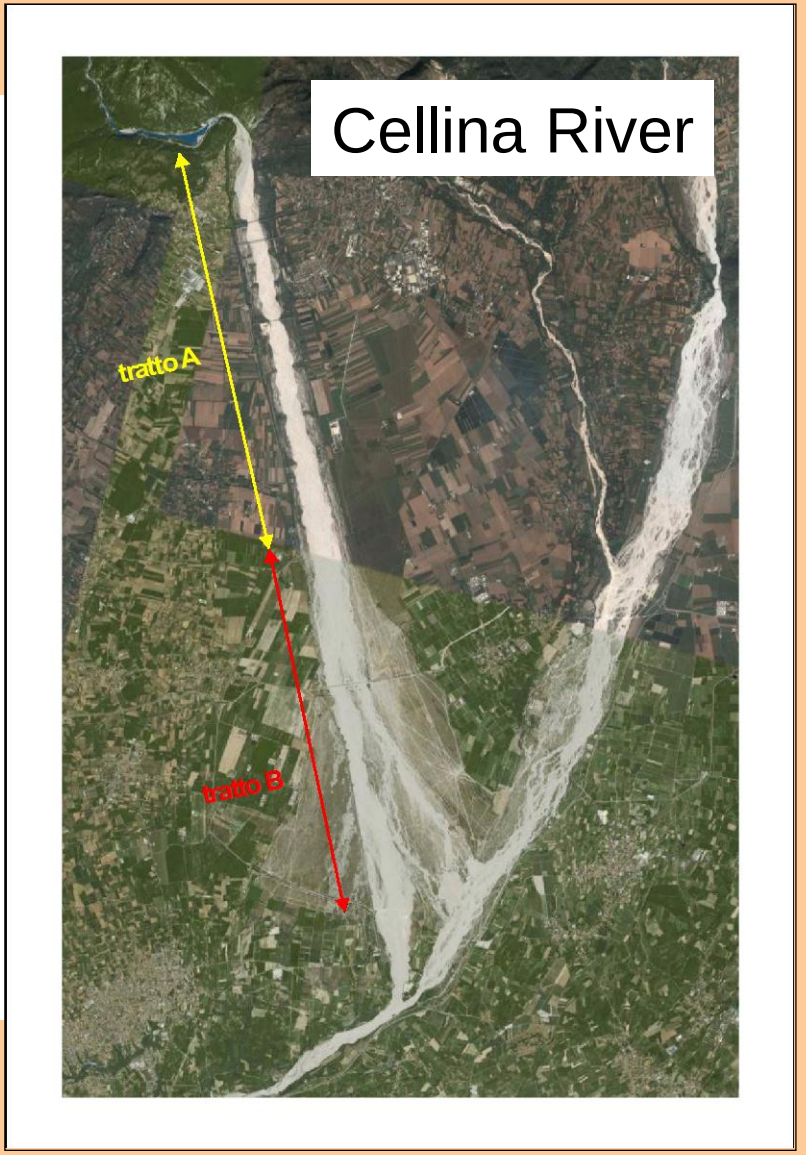
Sediment mining: extraction rates largely exceeded (10 times or more) replenishment rates

KEY QUESTIONS

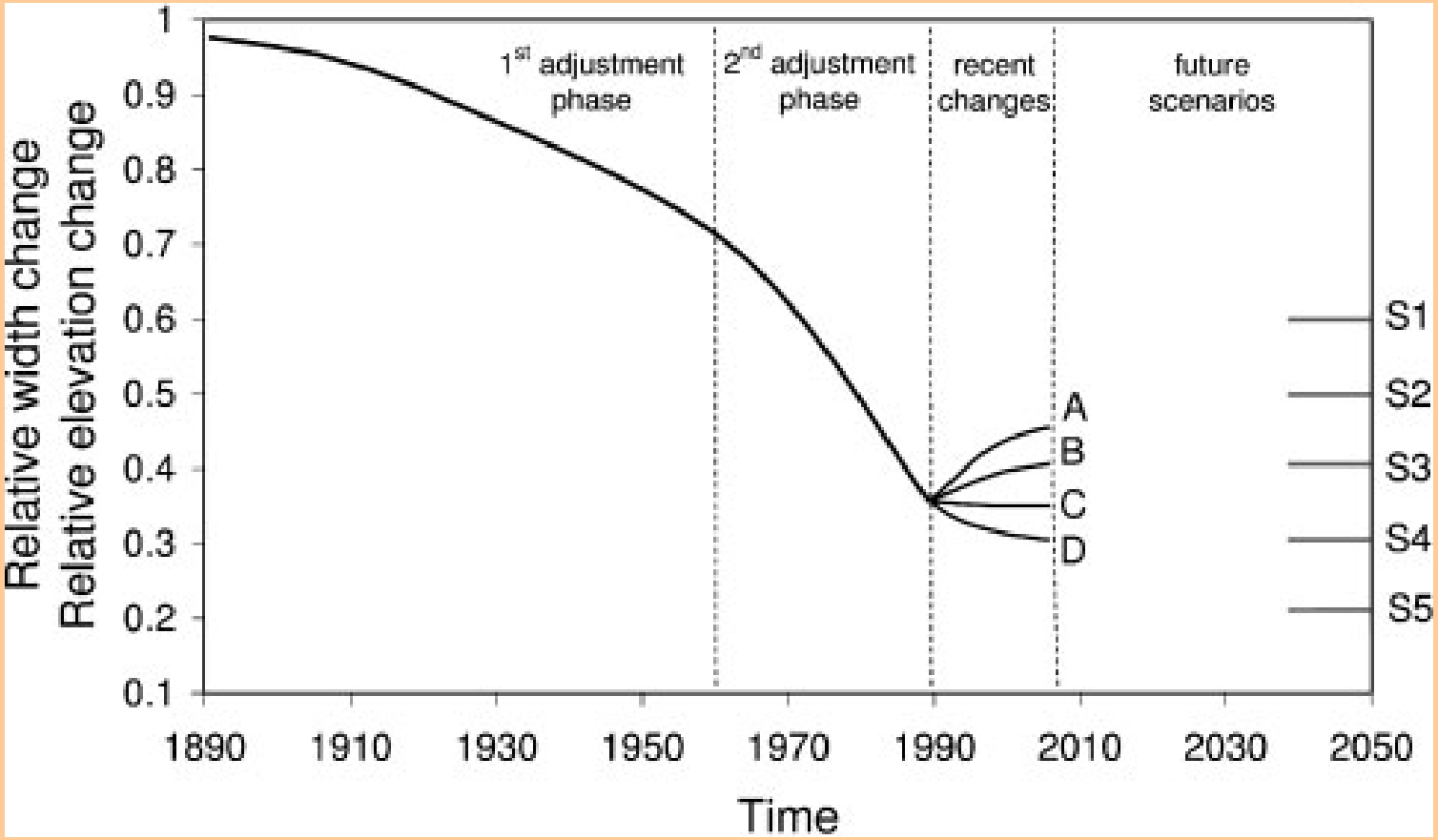
- How to manage/restore disturbed alluvial channels ?
- What is the channel recovery that could be expected in the next few decades ?
- Sediment management is a key issue in these rivers

SEDIMENT CONNECTIVITY





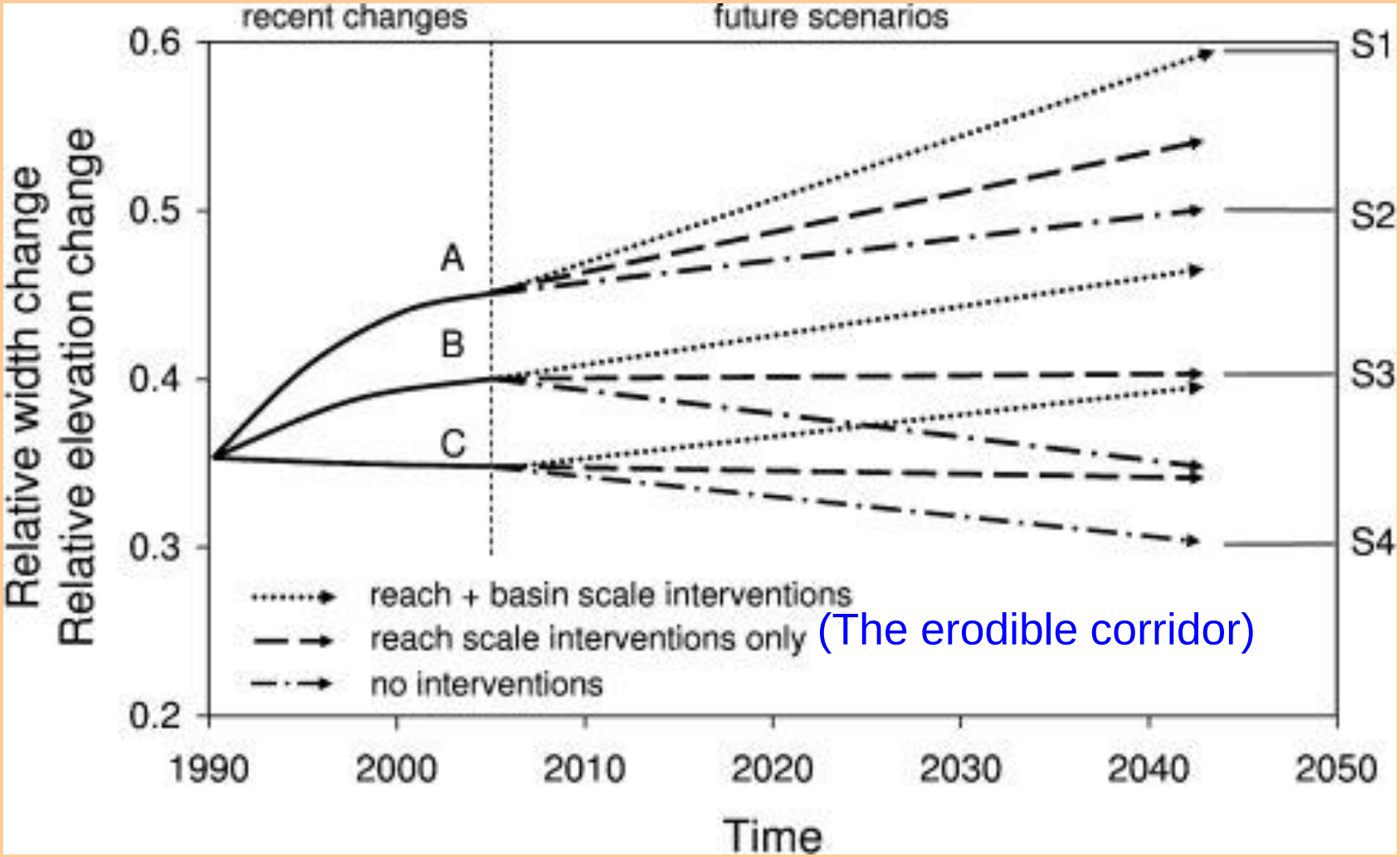
WHICH CHANNEL MORPHOLOGY CAN BE EXPECTED IN THE NEXT 40-50 YEARS ?



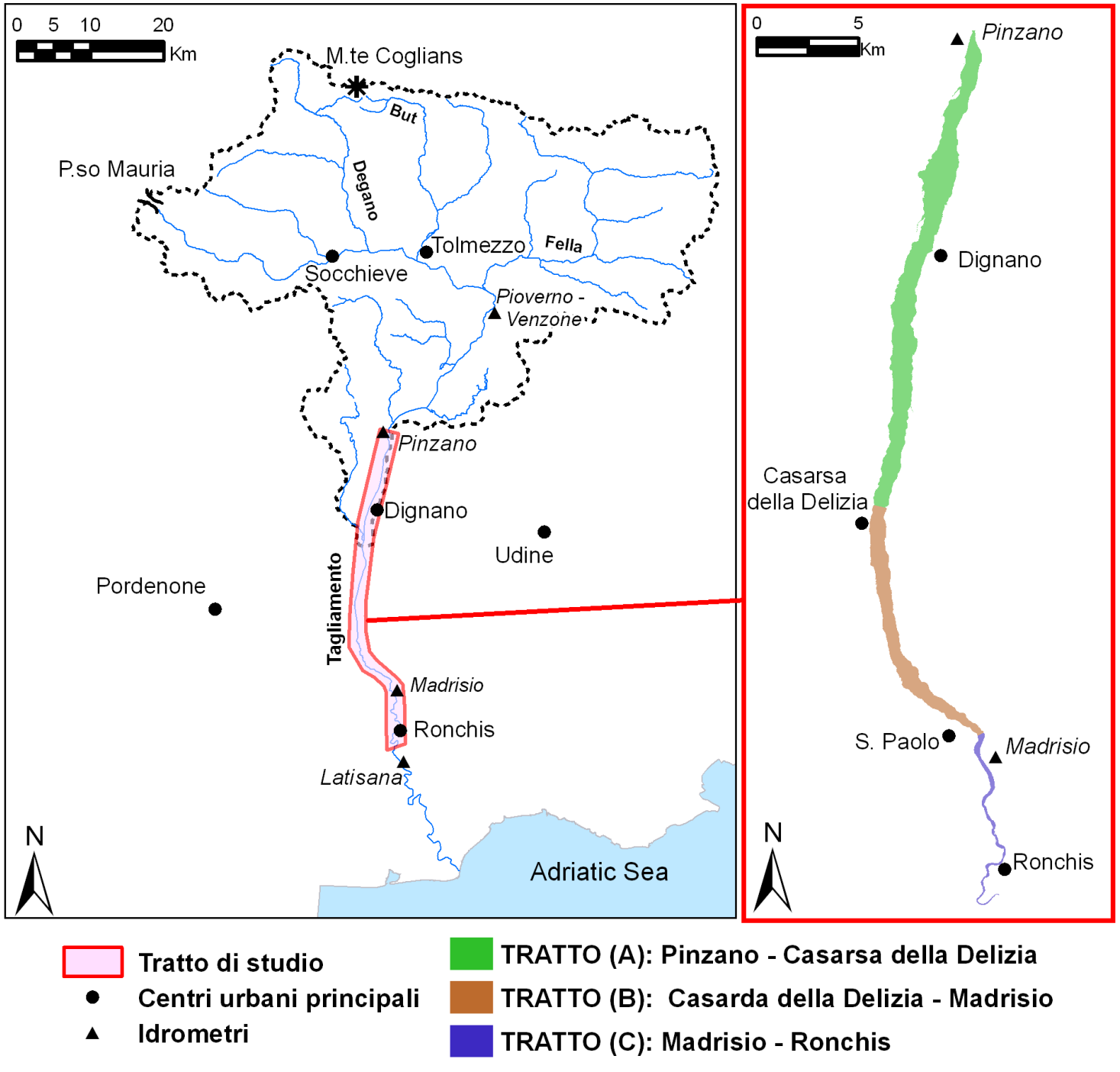
Assumptions:

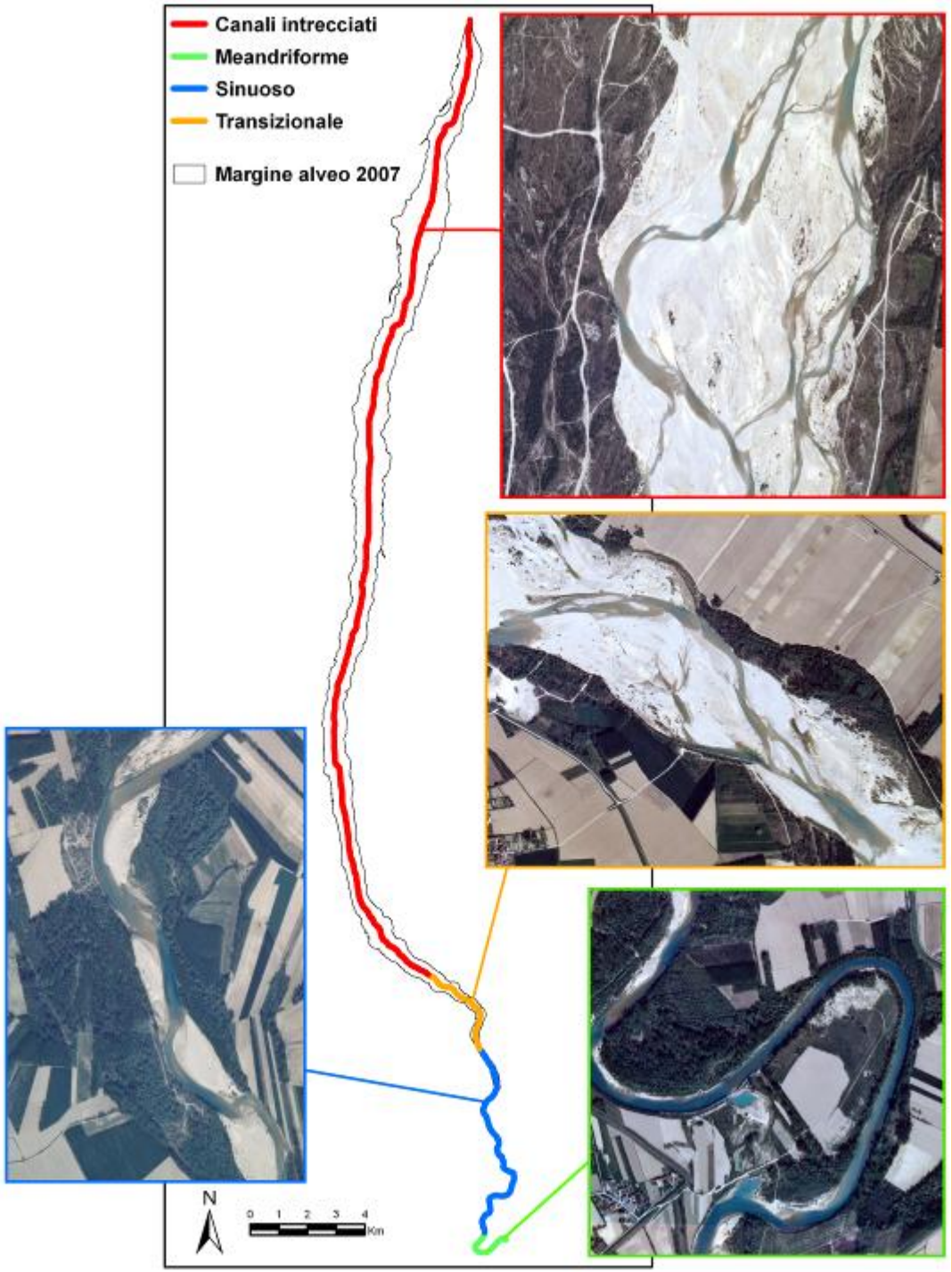
- No dramatic changes in land use
- Absence of very large flood events (e.g. > 100 yr return period)

FUTURE SCENARIOS OF CHANNEL CHANGES ACCORDING TO DIFFERENT STRATEGIES OF SEDIMENT MANAGEMENT



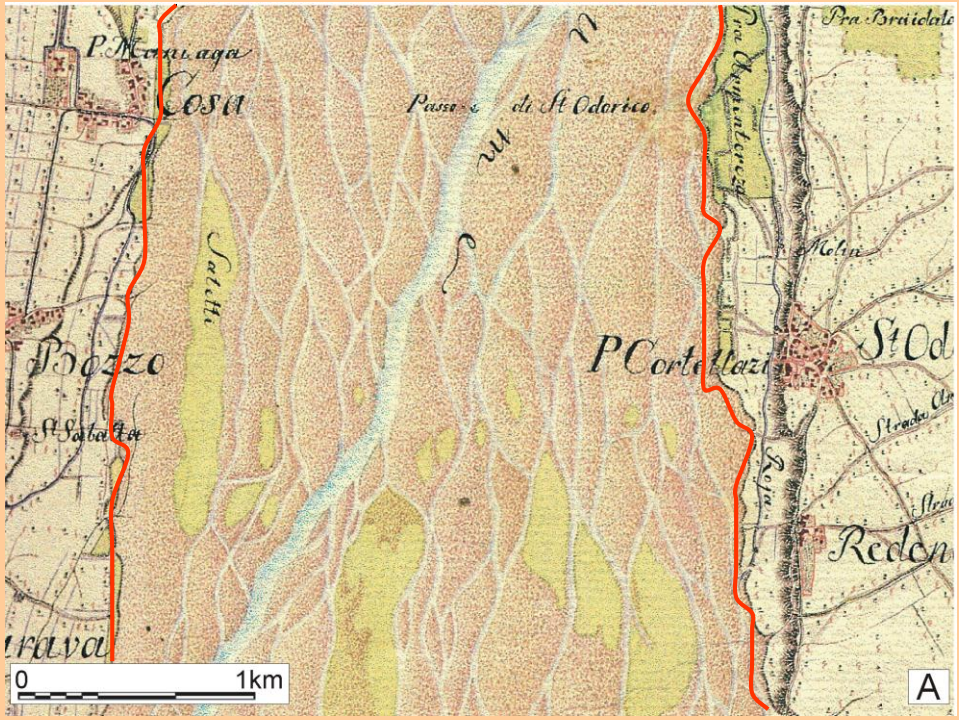
(The erodible corridor)


0 5 10 20
Km
M.te Coglians
But
Degano
P.so Mauria
Tolmezzo
Fella
Socchieve
Pioverno - Venzone
Pinzano
Dignano
Udine
Pordenone
Tagliamento
Madrisio
Ronchis
Latisana
Adriatic Sea
N
0 5
Km
Pinzano
Dignano
Casarsa della Delizia
S. Paolo
Madrisio
Ronchis
N
Tratto di studio
Centri urbani principali
Idrometri
TRATTO (A): Pinzano - Casarsa della Delizia
TRATTO (B): Casarda della Delizia - Madrisio
TRATTO (C): Madrisio - Ronchis

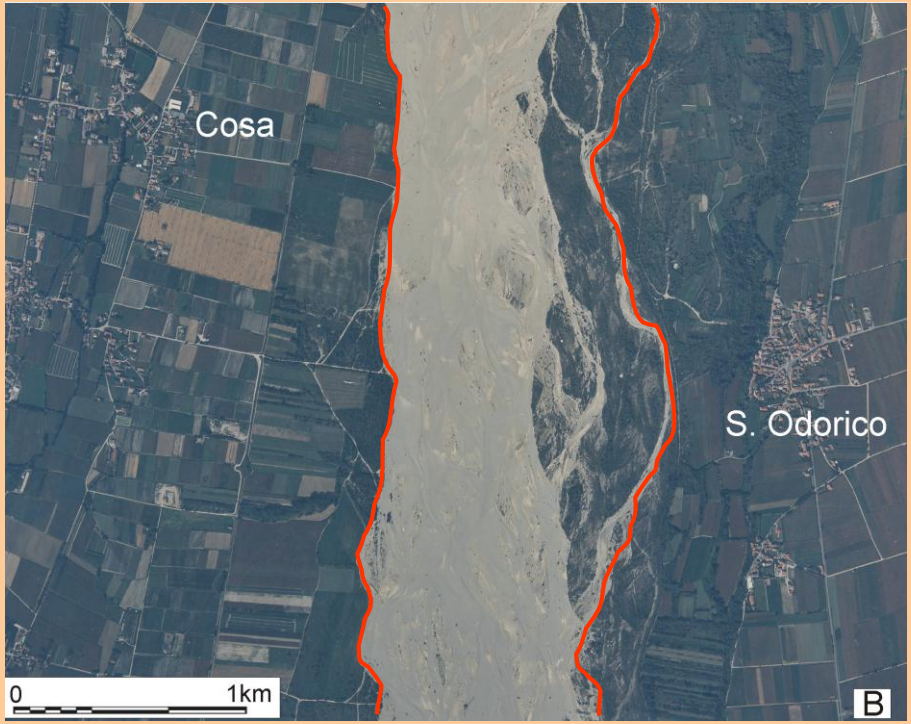

Canali intrecciati
Meandriforme
Sinuoso
Transizionale
Margine alveo 2007
N
0 1 2 3 4
Km

HISTORICAL MAPS AND AERIAL PHOTOGRAPHS

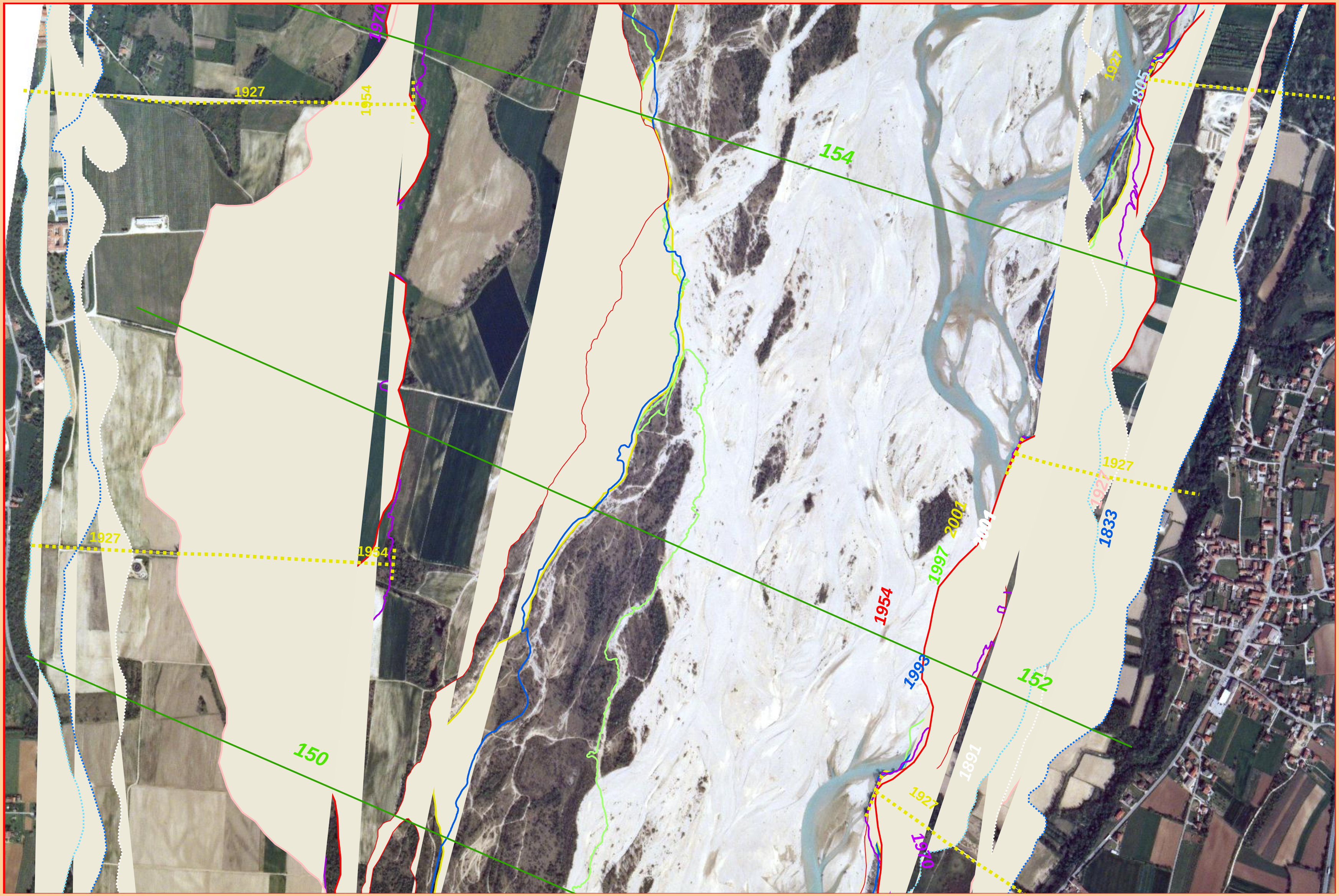
Year: 1801-1805



Year: 1999

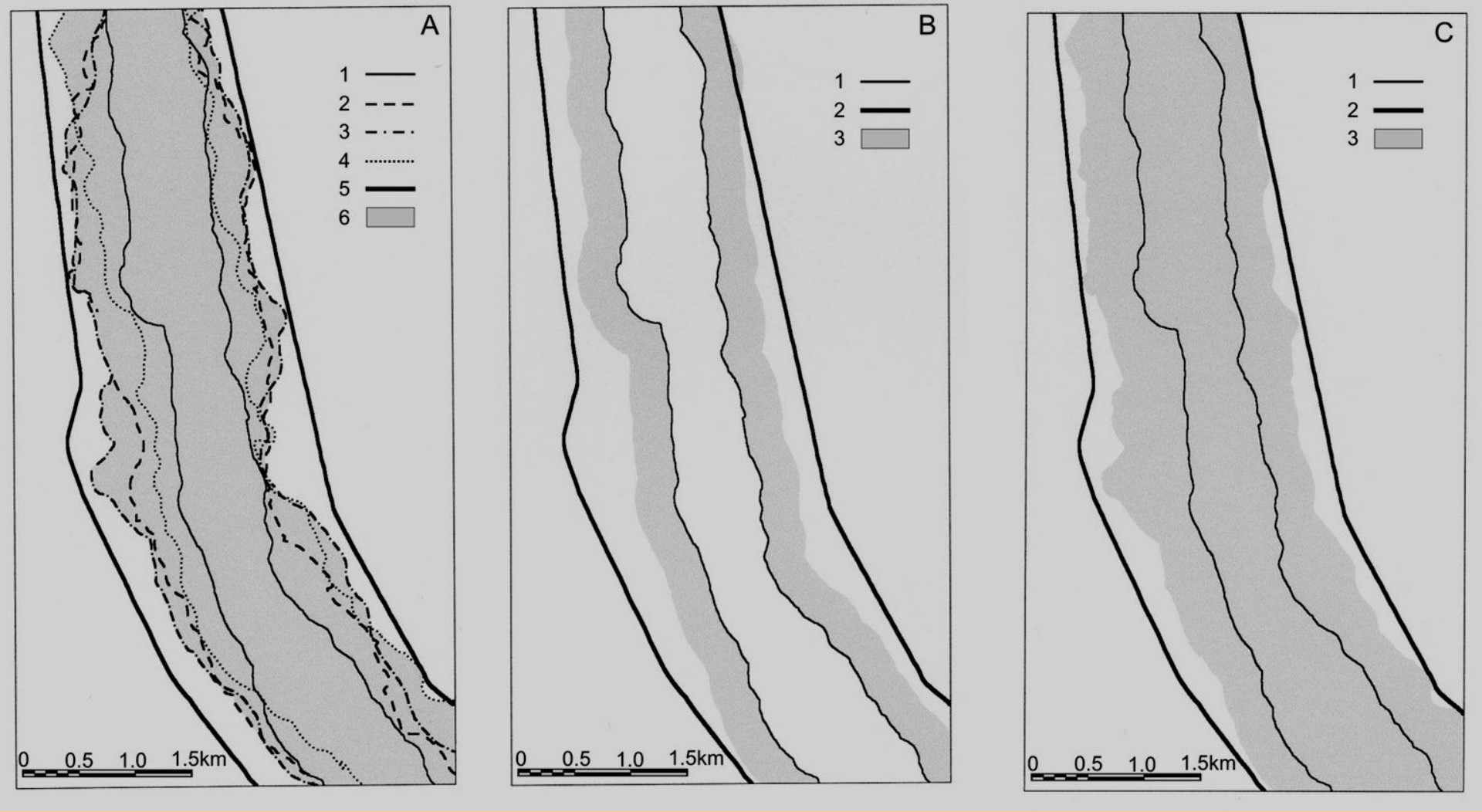


Tagliamento River: 14 dates from 1801 to 2009

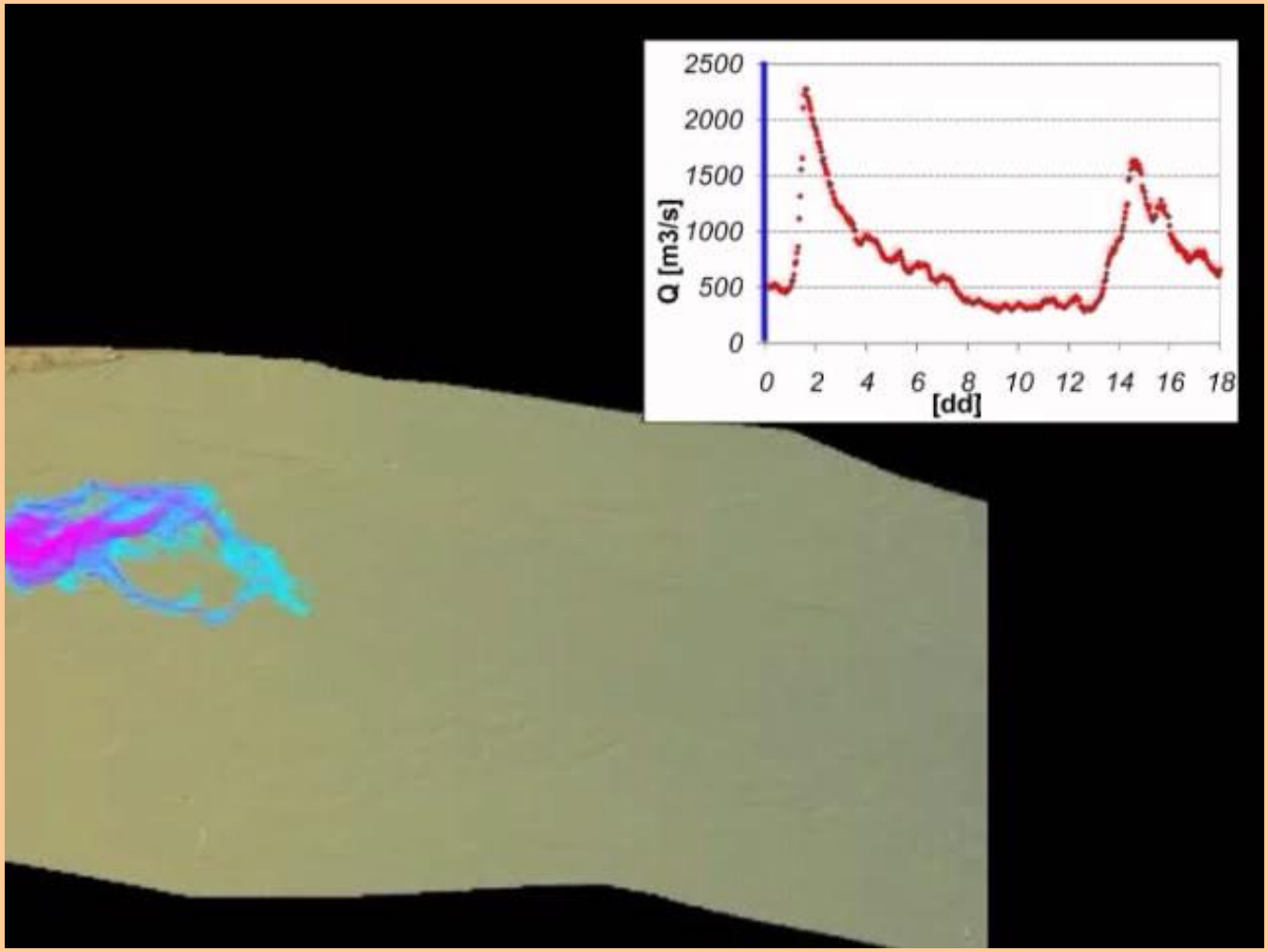


1970
1927
1954
154
1927
1805
1927
1954
1927
1927
2001
2004
1833
1997
1954
1993
152
150
1891
1927
1970

DEFINITION OF THE ERODIBLE CORRIDOR USING THE HISTORICAL APPROACH



Modelling long-term channel evolution using a reduced complexity cellular model (CAESAR; i.e. Coulthard et al., 2007)

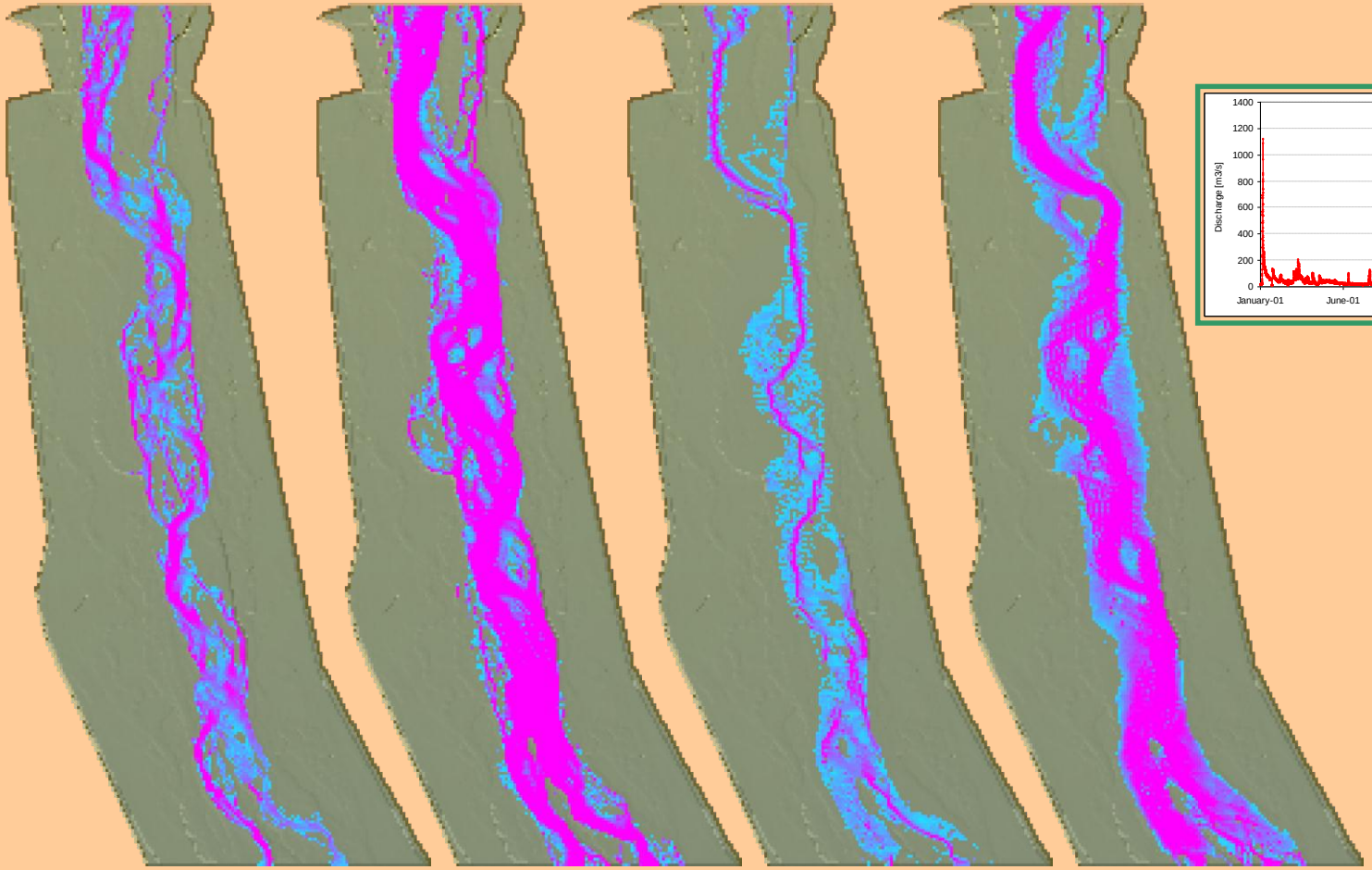


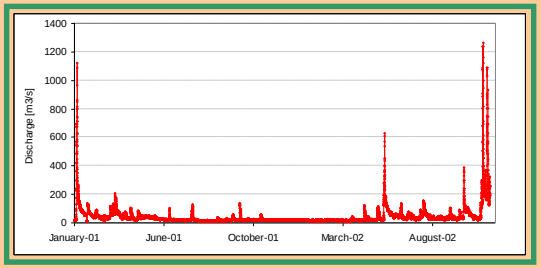
Tagliamento River

Tagliamento River (Luca Ziliani)

Reach length: 6 km; channel width: 400-700 m; simulation period: 23 months

Q=150 $m^3 s^{-1}$ Q=1040 $m^3 s^{-1}$ Q=100 $m^3 s^{-1}$ Q=600 $m^3 s^{-1}$





Work in progress: past (e.g. 1970-2001 in the Tagliamento) and future (next 40-50 years) long-term channel changes

CONCLUSIONS AND RESEARCH PERSPECTIVES

1. Existing approaches used to define the erodible corridor need to be revisited ?
2. Definition of the erodible corridor: integration of different tools (e.g. historical approach and numerical modelling)
3. Italian rivers: there is a lack of applications; there is a need to shift from theory (planning) to practice
4. An European network could be useful to stimulate the application of this concept in Italian rivers